PATENT SPECIFICATION

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(54) IMPROVEMENTS IN OR RELATING TO PRE-FABRICATED BRIDGE CONSTRUCTIONS

(71) We, N.V. BATAAFSE AANNEMING MAATSCHAPPIJ, a Dutch body corporate of Glashaven 18, Rotterdam, the Netherlands, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in or relating to bridge construction of the type assembled on the site from a comparatively small number of different prefabricated sections and provided with at least one deck section extending between two main girders.

At the present time such bridge constructions have wide fields of application such as, for example, for the temporary cutting of roads, during repair work, and for reclamation and communication purposes.

It is known in such prefabricated bridge constructions for each section to be a relatively short and complete portion of the bridge (i.e. comprising both girders and deck sections in one unit). In this arrangement, a relatively large number of successive bridge sections must be firmly interconnected throughout their contiguous zones, i.e. both at the regions of the girders and at those of the deck sections, and this is naturally time-consuming and very costly in manpower. In addition such sections, each of which forms a length portion of the bridge, are relatively awkward to handle in transport and to manoeuvre on site. If, with a view to easier transport the sections are in turn further sub-divided, this necessitates a further increase in assembly work on the site.

The invention provides a bridge construction of the kind assembled on site from a number of separate prefabricated sections and comprising at least one bridge deck extending between at least two bridge main girders each consisting of a plurality of successive sections conjoined and extending along the length of the bridge, said bridge deck consisting of a plurality of bridge deck sections which are short relative to the main girder sections, and said deck sections being rigidly connected to the main girder sections in which the main girder sections each comprise a rigid hollow triangular prismatic framework consisting of a plurality of joined beams, trusses or plates said framework being substantially triangular in cross-section transverse of the bridge and in which, in the assembled bridge construction, the bases of the triangular frameworks extend generally parallel to the bridge deck and the successive bridge deck sections abut each other along their adjacent edges.

Because the successive deck sections abut each other along their adjacent edges without any direct form of coupling, substantially no direct forces are transmitted between the adjacent edges of adjacent deck sections.

Preferably each side of the hollow triangular prismatic framework comprises a plurality of joined beams, trusses or plates which are themselves rigid in the plane of the side of the framework.

Preferably, successive main girder sections are coupled by a number of corresponding and engaging flanges which extend from each end of each girder section and which incorporates corresponding holes. The corresponding holes being aligned by means of an assembly extending through said holes and comprising an outer, peripherally interrupted sleeve with a solid tapered pin therethrough matching the slightly conical inner circumference of the sleeve, said pin having a central tapped hole fitting a tightening bolt supporting its head against the bottom of a cup-shaped member aligned with said sleeve and receiving an end portion of said pin.

Preferably for the connection between the main girder and deck sections, vertically spaced support surfaces provided with upwardly extending tapered centering pins are formed on said main girder sections, and brackets project

from the ends of said deck sections at vertically spaced positions, said brackets being provided with holes corresponding with said pins.

Preferably at each of at least a number of the points of connection between a deck section and a main girder section there is provided a centering member, said centering member comprising a plurality of downwardly extending laminae with an external and internal form respectively corresponding to the wall of said hole and the outer surface of the tapered pin, and means for axially forcing and retaining the laminae between the tapered pin and the hole so that the laminae extend downwardly between the wall of said hole and said pin to centre the hole about the pin and retain the connection between the deck section and the main girder.

A preferred embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which:—

Figures 1, 2 and 3 show respectively and diagrammatically an elevation, plan and cross-section of a prefabricated bridge construction according to the invention;

Figure 4 shows a perspective view of an end portion of a main girder section and a deck section for connection thereto, with a coupling member of a successive main girder section to be connected to said main girder section;

Figure 5 shows, on a larger scale, a side elevation in partial cross-section of connecting members of a main girder section and a deck section in assembled condition; and

Figures 6a to 6d show perspective views, on an enlarged scale, of parts of a coupling assembly for the mutual coupling of main girder sections.

In Figures 1 to 3, there is shown a prefabricated bridge construction, having a span 1 between arrows. The bridge deck between the main girder sections 3 and 4 is indicated by the reference numeral 2. The main girder sections 3 and 4 are in the form of long open frames which, as shown in Figure 3, have in cross-section the shape of an isosceles triangle.

The upright sides 3a, 3b and 4a, 4b respectively of the open frameworks are of truss-like form as shown in Figures 1 and 2. The bases 3c and 4c are each in the form of box girders as shown in Figure 4.

In the illustrated assembled condition the bases 3c and 4c are rigidly connected to the paving sections 2 lying therebetween and such as to be further described herein.

In the illustrated embodiment a measurement of 2.62 meters has been chosen for the heights of the main girders, and the main girder lengths are constructed in lengths which are multiples greater than 1 or 3 metres, e.g. 12 meters.

Both main girders are built up of sections in, for example lengths of 12, 15 or 18 metres, which are rigidly coupled one to another to form continuous girders from support to support. The girders are torsionally stiff about their longitudinal axes, because of their triangular transverse cross-section.

In the present described construction and in the bridge length direction, the bridge deck 2 is made up of successive sections each measuring 3 metres long, and which span the space between the main girders 3 and 4.

The deck width in this case is 4.8 metres. In cross-section, the width of each main girder is 1.5 metres and thus the total bridge width is 7.8 metres in the present case. In the assembly of the prefabricated bridge construction, for example, first the successive sections of a main girder are mutually coupled. The sections are in the form shown in Figure 4, provided with flanges such as 5 extending from the 3 corners of the triangular construction at one end, and with flanges such as 6 extending from the 3 corners at the other end.

At the manufacturing stage in the factory these flanges extending lengthwise are provided with clearance holes corresponding to the holes in a corresponding flange or flanges in the next successive following main girder section. The double flange version 5 is arranged to receive the single flange version 6 therebetween in an overlapping codition for some distance in the bridge length direction.

For the mutual coupling on site the flanges 5 and 6 of successive sections are manoeuvred together to cause the flanges 6 to be sandwiched between flanges 5 and such that initially the corresponding holes in the flanges 5 and 6 are roughly lined-up. In this condition they are sufficiently in alignment to accommodate the sleeves 8 shown in Figure 6a. These sleeves are split longitudinally, where designated by the reference numeral 9 and terminate at one end in a flange. The form of the hole through the sleeve is slightly tapered. On the end opposite to the flanged end when sleeve 8 is placed in the holes, a cup-shaped member 10 having a bottom 11 with a central hole 12, shown in Figure 6b, is subsequently placed over the end of sleeve 8.

Thereafter a conical pin 13, shown in Figure 6c is inserted from the flanged end into sleeve 8, and from the opposite end a bolt 14 is inserted through hole 12 of member 10 and screwed into a portion 13′ having female threading at the inserted end of a central, longitudinal throughbore in pin 13. By tightening bolt 14, pin 13 is tightened to widen sleeve 8 until the hole through flange 6 is fully in register with the two aligned holes through flanges 5.

When the main girders 3 and 4 have thus been assembled, and have been erected, for example where they have to be installed, or on a site whence the completed pre-fabricated bridge construction can be transported further (for example, it may be transported to its destination via waterways), the deck sections 2

are hung between the two main girders 3 and 4.

As shown in Figure 4, the main girder sections are provided for the purposes with vertically spaced-apart, horizontal support surfaces 21 and 22, carrying upwardly extending, tapered centring pins 23 and 24, respectively.

Extending from deck sections 2 in the direction of the distance spanned by said sections between main girders 3 and 4 are brackets 25 and 26, respectively corresponding in the longitudinal direction with support surfaces 21 and 22, and respectively provided with holes 27 and 28, corresponding with pins 23 and 24, respectively.

As shown in Figure 5, the holes 27 and 28 have a wide clearance around the frusto-conical pins 23 and 24, respectively. During assembly, brackets 25 and 26 can in the first instance be lowered over the pins.

Figure 5 shows a support plate 25' welded against the bottom of bracket 25, and through which the deck section is supported on the support surface 21 of the main girder.

In the first instance the holes 27 and 28, are, in this stage of the assembly, not yet accurately centred around the axes of the pins 23 and 24, respectively. Centring is affected by means of assemblies comprising centring means, generally indicated at 29 and 30, respectively, for the lower and upper points of connection between the main girder and paving sections.

These assemblies 29 and 30 each include an expandable cylindrical member comprising a circle of four laminae 31, 32 having the shape shown in Figure 5, and several millimetres thick. The tapered lower end of each laminae is shaped to conform on one side with the tapered form of pins 23, 24 and on the other with the wall of the holes 27, 28. At the bottom and top of Figure 5, the four laminae of each expandable member are connected by a ring 33, 34 with a central hole through which extends a bolt 37, 38 having a threaded lower end, by which it is screwed into a mating central screwthread of the pin 23, 24 concerned, which extends from the support surface 21, 22 respectively. Plates 35, 36 are attached to rings 33, 34 respectively and allow rotation of bolt 37, 38, respectively. Plates 35, 36 are retained in position relative to bolts 37, 38, respectively, by nuts 39, 40, respectively, the nuts being screwed under the plates on to the lower end of the respective bolts 37, 38, and the bolt being widened above the plate. The assemblies formed by the laminae 31, 32 rings 33, 34 and plates 35, 36 are thus retained in position on the bolts 37, 38.

In the case of bolt 37, the widening is formed by a long shank portion 41 having a threaded top end on which is screwed a nut 42, and at its extremity a further nut 43, which is fixed with a pin, so that rotation of nut 43 will rotate bolt 37, to turn its lower end home into the pin. During this operation the shoulder formed at the lower end of the shank portion 41 of bolt 37 will force plate 35 and hence ring 33 with the circle of laminae 31 downwardly, so that the centring assembly will centre the wall of hole 27 around the axis of pin 23. When the centring circle has been pushed downward far enough, and centring has been accomplished, the connection can be locked at the top by means of nut 42.

The long shank with the fixed nut 43 and locking nut 42 at the top makes it possible to centre and lock the connection at the lower point of connection from above in a simple manner, the latter being difficult for direct access.

In the centring assembly for the upper point of connection, instead of the shank 41 with nuts 42 and 43 just described there is only provided a head 44 on bolt 38 for locking the upper connection when centring has been accomplished in the same manner, as the centring at the lower point of connection. Since the head 44 bears directly against the plate 36, no separate lock nut is provided.

It will be clear that the invention is not limited to the embodiment shown in the drawings and described herein, but that various variant and modified embodiments are possible without departing from the scope of the claims.

Thus, for example, the bridge construction may comprise more than two main girders. Also, constructions are conceivable in which there are two lateral main girders and one or more intermediate main girders, all interconnected by deck sections.

Furthermore, the cross-sectional profile of the main girders, rather than projecting upwardly from the deck sections, may extend downwardly relative to them, In that case since the girders are of triangular-cross section, the apex of the triangle will point downwardly. In this way, the bridge deck may include the upper surface of the main girders. Combinations of upwardly and downwardly extending girders are also possible.

As regards the sequence of assembly, deck sections may already be mounted between main girder sections before the latter are interconnected with adjacent girder sections.

WHAT WE CLAIM IS:—

1. A bridge construction of the kind assembled on site from a number of separate prefabricated sections and comprising at least one bridge deck extending between at least two bridge main girders each consisting of a plurality of successive sections conjoined and extending along the length of the bridge, said bridge deck consisting of a plurality of bridge deck sections which are short relative to the main girder sections, and said deck sections being rigidly connected to the main girder sections, in which the main girder sections each comprise a rigid hollow triangular prismatic framework consisting of a plurality of joined

beams, trusses or plates, said framework being triangular in cross-section transverse of the bridge and in which, in the assembled bridge construction, the bases of the triangular frameworks extend generally parallel to the bridge deck and the successive bridge deck sections abut each other along their adjacent edges.

2. A bridge construction as claimed in claim 1, in which each side of the hollow triangular prismatic framework comprises a plurality of joined beams, trusses or plates which are themselves rigid in the plane of the side of the framework.

3. A bridge construction as claimed in claim 1 or claim 2 in which the successive main girder sections comprise interengaging flanges including corresponding holes, said sections being aligned and connected by means of assemblies extending through said holes and each comprising an outer peripherally interrupted sleeve with a solid tapered pin therethrough matching the slightly conical inner circumference of the sleeve, said pin having a central tapped hole fitting a tightening bolt supporting its head against the bottom of a cup-shaped member aligned with said sleeve and receiving an end portion of said pin.

4. A bridge construction as claimed in any one of the preceding claims, in which, for the connection between the main girder and deck sections, vertically spaced support surfaces provided with upwardly extending tapered centering pins are formed on said main girder sections, and brackets project from the ends of said deck sections at vertically spaced positions, said brackets being provided with holes corresponding with said pins.

5. A bridge construction as claimed in claim 4, in which at each of at least a number of the points of connection between a deck section and a main girder section there is provided a centering member, said centering member comprising a plurality of downwardly extending laminae with an external and internal form respectively corresponding to the wall of said hole and the outer surface of the tapered pin, and means for axially forcing and retaining the laminae between the tapered pin and the hole so that the laminae extend downwardly between the wall of said hole and said pin to centre the hole about the pin and retain the connection between the deck section and the main girder.

6. A bridge construction substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1

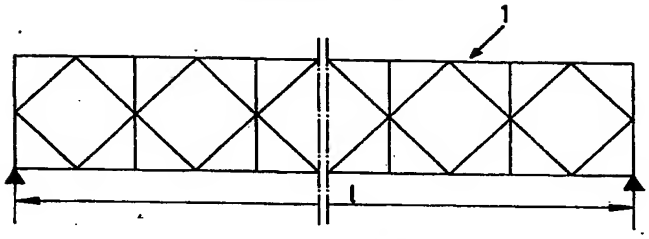


Fig. 2

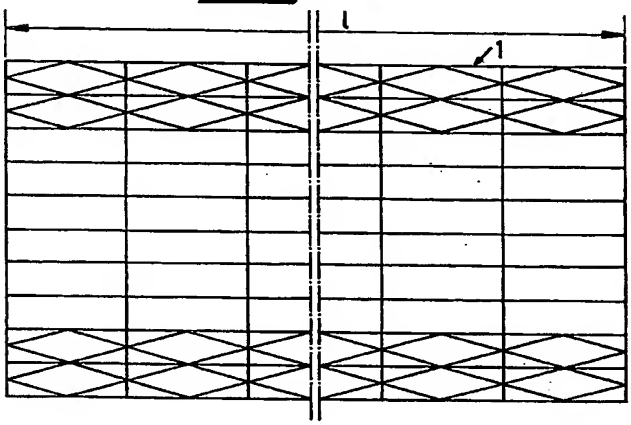
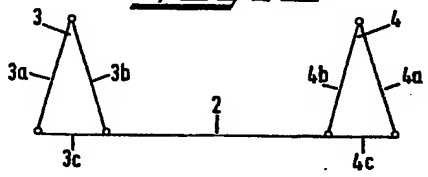


Fig. 3



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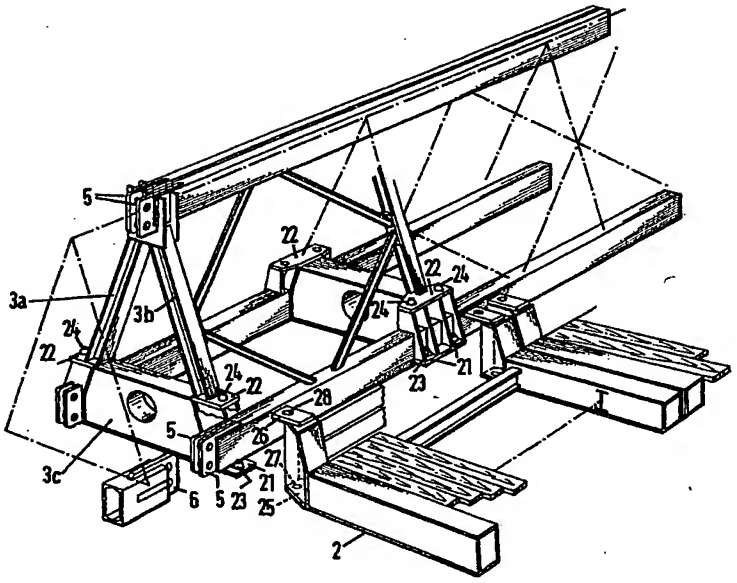
Sheet 2

Fig. 4



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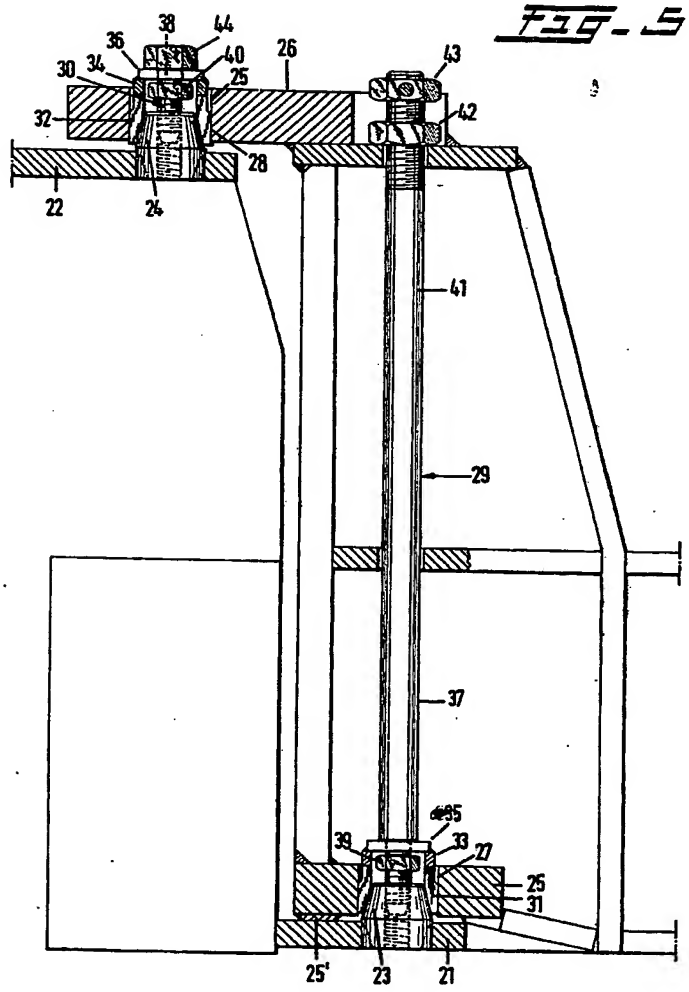
Sheet 3

Fig. 5



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Sheet 4

Fig. 6